

**ASSESSMENT OF LEARNING IN TEAM BASED LEARNING (TBL) EDUCATIONAL SESSIONS**

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**PURPOSE.** In 1984, the Association of American Medical Colleges (AAMC) recommended a change in curriculum for medical education. It was not until 1997 that team-based learning (TBL) was developed for business courses, and then incorporated in 2001 for medical schools. Tulane integrated TBL into the medical basic sciences curriculum in 2008 as part of the “Mechanism of Diseases” course. The purpose of this study was to assess the initial progress of students’ grades in those block groups with TBL sessions, and to evaluate the Pathology Shelf Exam grades pre- and post-implementation of TBL.

**METHODS.** For this purpose, we reviewed TBL objectives, individual readiness assessment test (IRAT), and group readiness assessment test (GRAT) questions. We also reviewed exam questions (and grades) covered by TBLs, and compared grades of questions from those exams with grades from pre-TBL year (2007) and mean exam grades from 2007 to 2009 (including NBME performance in specific content areas).

**RESULTS.** Student performance improved on internal exam questions relating to 3 of the 4 specific content areas covered by TBLs, although the increase was not statistically significant ( $p>.05$ ). There was a significant decline in student performance on internal exam questions relating to the Coagulation content area from pre-TBL to post-TBL ( $p<.01$ ). Overall, mean student performance on the Cardiovascular exam (Heart Failure TBL) improved significantly from pre-TBL to post-TBL ( $p<.01$ ). However, mean student performance on the Neoplasia/Hematology exam (Coagulation TBL) declined significantly from pre-TBL to post TBL ( $p<.01$ ).

**CONCLUSION.** Given that TBL will become a more integral part of the basic science curriculum moving forward, continued monitoring of student performance is recommended to gauge the impact of TBL on student learning.

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**DIABETES TBL: GENESIS OF A MODIFIED TBL SERIES FOR MEDICAL BIOCHEMISTRY**

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**PURPOSE**

Team-based learning enables students to self-teach themselves and team members, provides concrete active learning, holds students responsible for their education, and shifts students from passive learners to active participants. In our Metabolic Biochemistry course, diabetes was previously taught in five didactic lectures. To convert this material into a TBL format, we had to determine how best to: (1) convert a complex topic like diabetes into a traditional 2-hour TBL format, (2) provide pre-Learning resources of modest length, and (3) cover the full range of material in a single session without diluting the depth at which these concepts were presented.

**METHODS**

These problems were overcome by modifying the traditional TBL format to include three stand alone IRAT/GRAT sessions, each one-hour session covering material of major topics from three distinct learning objectives. A comprehensive one-hour GAE session followed.

**RESULTS**

The average team GRAT scores (9.72 out of 10 points) were 18% greater than student IRAT scores (7.93 out of 10 points), suggesting effective team teaching. Team-discussed GAE questions were similarly well answered (4.54 out of 5 points). Students utilizing the modified TBL series increased their exam scores by 2.75 points (a 3.2% increase), as compared to past students learning the same material from traditional lectures. Student evaluations ranged from 3.88 to 4.33 on a five-point Likert scale. Student written comments were similarly very supportive of this active learning series.

**CONCLUSIONS**

The diabetes TBL series is popular. Student performance is equal to, or better than, performance from previous years taught in traditional lectures. The TBL series provides self- and team-learning. IRAT/GRAT quizzes stimulate team interactions, and deter procrastination. Instructors can convert several theme-based lectures into a modified TBL series without scheduling additional sessions or diluting topic. Finally, breaking pre-Learning reading assignments into three sessions didn't overwhelm students with cognitive overload.

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**SECOND YEAR MEDICAL STUDENTS AS PEER FACILITATORS IN PBL TUTORIALS: A RECIPE FOR SUCCESS?**

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**PURPOSE**

Anecdotal observations indicate that some 2nd year medical PBL groups can maintain effective tutorial environments without facilitatory assistance from their tutors. This study was conducted to determine: (1) if second year PBL groups could benefit from peer-facilitated tutorials (PPFBL) and (2) the impact of participating in PPFBL on the academic performance.

**METHODS**

The study was conducted during the 4 week Reproduction block. Three PF and three control groups, each consisting of 8 students volunteered to participate. Of the three weekly tutorials, each of the first two was facilitated by a different peer facilitator (PF), the last one by the faculty tutor. Confidential guides, developed to emphasize key concepts of the case and list potential learning issues, were distributed to the PFs via email before the relevant tutorials. PFs were required to pre-read the guides but not to become 'content experts'. At the end of each PF tutorial all participants assessed their experience using five-point Likert scales. All PF and control students completed weekly anonymous quizzes, each consisting of six multiple choice questions emphasizing key concepts of the case. Finally, written examination grades were used to determine the impact of PPFBL on participants' academic performance.

**RESULTS**

All three PF groups provided very positive assessment of the Group Dynamics, Individual Contributions, Professionalism, Peer Facilitator and Effectiveness of Tutor-less Sessions (4.52, 4.30, 4.55, 4.35, and 4.45 out of 5, respectively). Average quiz scores were statistically similar, both within and between treatments. Participation in PF tutorials had no impact on written examination scores (ANCOVA with the average first year examination scores used as covariate).

**CONCLUSIONS**

Properly structured PPFBL can provide highly rewarding and stimulating learning environment without jeopardizing participants' academic performance. Offering PPFBL can serve as an effective strategy to renew, often eroded among second year medical students, sense of excitement about PBL process.

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**DOES STUDENT AND FACULTY PBL GROUP ASSIGNMENT AFFECT EXAMINATION PERFORMANCE?**

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**PURPOSE**

Medical student examination performance in an integrated problem-based learning (PBL) curriculum related to group and faculty facilitator assignment has not been well studied. At our university preclinical basic sciences are taught concurrently in 12 modules from 5 to 7 weeks long with 9 hours of group sessions per week. Students are numerically graded by a single integrated multiple-choice examination following each module. This study asks: does the group and faculty to which a student is assigned affect examination performance?

**METHODS**

The neurology (NE), musculoskeletal (MS), cardiovascular (CV), and endocrine (EN) modules of the curriculum from 2006 to 2009 were studied. Class size ranged from 52 to 61 students, with 8 or 9 groups per module, and 5 to 8 students with a single faculty facilitator per group. Both faculty and student group assignments changed for each module. There were 47 individual faculty facilitating 1 to 8 groups each. There were 136 total groups with 65 facilitated by practicing clinicians and 71 by basic scientists. A total of 917 student examination scores were recorded. A one-way analysis of variance (ANOVA) test was performed using the method of Kolmogorov and Smirnov applied to individual student scores by module group and by facilitator, with Tukey-Kramer Multiple Comparison test if  $P < 0.05$  for the ANOVA.

**RESULTS**

Only 6 groups (4.4%) with 6 different facilitators in 5 modules (2 NE, 2 MS, 1 EN) had non-Gaussian student examination score distributions, 4 above and 2 below the class average. There were no significant differences in student examination scores between groups facilitated by clinicians or basic scientists or by faculty discipline expertise. **CONCLUSION** Tutorial group and faculty facilitator assignment by clinical or basic science background or discipline expertise had no significant effect upon student examination performance in an integrated basic science PBL curriculum.

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**INTEGRATION OF PRACTICALS IN TEACHING PATHOLOGY USING THE CARDIORESPIRATORY SYSTEM COURSE AS A MODEL.**

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**PURPOSE**

To develop a model for integrating the teaching of pathology in the third year problem-based curriculum of Moi University School of Medicine. In Kenya, the first two years of medical school are considered basic, anatomy, physiology, biochemistry and introduction to immunology and pharmacology while the third year has been for teaching the abnormal: pathology and pathophysiology. The teaching is primarily problem-based and integrated with a few lectures and overviews given by the various departments. The practicals are usually organised by each department, the time being allocated by the course director. Each department is usually allocated six hours in a week (a total of thirty hours) since the class is divided into two groups. Currently students have major deficiencies integrating across disciplines especially in the practical. To address this problem we developed a trial module to integrate all the practicals from various departments as one practicum (combined practical session).

**METHODS**

The five-week course on the Cardiorespiratory System was chosen to test the model. A faculty member from the department of Human Pathology and Forensic Medicine, who teaches the course, was involved in restructuring and directing the course. Additional information was added to the already existing tutorial problems. The course was introduced by the course director and the faculty members from various departments and tutorial booklets containing all the tutorial problems for the course and feedback forms were given to students. Tutorials were held as usual twice a week. Day 1 usually a Tuesday afternoon being used to raise objectives for a particular tutorial problem. Additional information was given by the tutors and students allowed to read, research and come for the discussion on day 2 usually a Friday morning. Two integrated practical sessions (a total of twelve hours) were organised where all the departments teaching the course were involved. A feedback form/questionnaire was issued at the end of the practical to be filled and brought in the following day.

**RESULTS**

Evaluations of continuous assessment tests (CATs), usually called end of term exams (ETE) and feedback from students after the new course were compared with those from the previous year.

**CONCLUSIONS**

The results of this pilot module will be used to further develop a model for integrating the teaching of pathology within PBL as well as integrating subjects across disciplines in an effective and time saving manner.

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**VIRTUAL PBL WITH ONLINE FACILITATION: TRAINING LEARNERS IN ONLINE COMMUNICATION AND FEEDBACK**

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**PURPOSE**

Student trained in Problem Based Learning (PBL) have been found to perform better during the clinical years and exhibit high enthusiasm. However, PBL is faculty-intensive and is dependent on well trained tutors who will not dominate the group. The goal of this study was to enhance live PBL by using a virtual group interaction with a virtual faculty facilitator. Contact between learners and the tutor was online only, allowing the group dynamic to proceed in a virtual environment with faculty coaching. We sought to provide a more open, independent learning setting, more closely simulating the clinical environment.

**METHODS**

Two second year medical student groups (n = 12) participated as volunteers, sharing a common facilitator. Sequential case handouts were posted to the group via a shared Google document. Students added to the document and used it as a forum for discussion. A deadline was given to the students for completion of each assignment. The facilitator would check the document daily and then post more data or pose additional questions. Students could meet live or virtually as the group wished, and met with the facilitator for post-case wrap up. Peer feedback was provided anonymously after the case.

**RESULTS**

Compared to traditional "live" PBL, students reported more time spent on the case, higher quality group interaction, and a lower frequency of quiet students' being non-participatory. Stress, learning, and enjoyment were not different. Narratives described reticent members becoming more participatory and broader participation than in normal PBL. Students felt that peer feedback was more accurate, specific, and more likely to induce behavioral change than previously received PBL faculty feedback. Conclusion Virtual PBL succeeded in facilitating online group learning with fewer faculty. There was better group interaction. Some students who were reticent in normal PBL were more participatory. Peer feedback was felt to be superior to that of faculty. Virtual PBL is promising in situations with limited faculty and for training students in virtual communication strategies.

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## **CONCEPT MAPPING AS A TEAM-BASED LEARNING APPLICATION EXERCISE IN A FIRST YEAR MEDICAL BIOCHEMISTRY COURSE**

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### **PURPOSE**

To evaluate the effect of concept mapping in a team-based learning model on first-year medical student performance and perception of learning.

### **METHODS**

The Biochemistry and Molecular Biology course is delivered using a modified team-based learning method. Briefly, the course consists of a Readiness Assurance Process (RAP) for each module and case-based team application exercises emphasizing the integration of concepts covered in the RAP. For each case, teams answer multiple-choice questions (MCQ) and report the answers simultaneously in the large group. This year (2009-10), teams also generated a concept map as part of the case application exercise to illustrate the connections between basic science concepts and pertinent clinical details of the cases (e.g. symptoms, lab values). Teams exchanged concept maps and provided written feedback using a grading rubric. Following the exchange, teams had an opportunity to revise the maps and use them to answer the team MCQs for the case. At the end of the session, maps were graded by the course faculty using the same rubric. To assess the effect of concept mapping on student performance, we compared results on 72 MCQs that appeared on both 2008-09 and 2009-10 exams. Student satisfaction and engagement was assessed from course evaluation surveys from 2008-09 and 2009-10.

### **RESULTS**

The average percentage of students answering correctly on the MCQs increased from 65.23% + 2.3 (2008-09) to 72.70 + 2.08 (2009-10;concept mapping) ( $p < 0.001$ ). This result correlated with an increase in time spent preparing for class ( $p < 0.001$ ), perceived gain of factual knowledge ( $p < 0.001$ ) and reported connection of basic biochemistry to medicine ( $p < 0.01$ ). There is no difference between the average GPA and average MCAT scores for the two classes.

### **CONCLUSIONS**

The addition of case-based concept mapping to the application exercise of a team-based learning model improves performance of first year medical students on MCQs, increases engagement and motivates students to spend more time preparing for class.

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**IMPROVEMENT OF PROBLEM-BASED LEARNING BY IMPLEMENTING CASE-BASED REASONING INTO STUDENT PRESENTATION**

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**PURPOSE**

Of various teaching strategies, problem-based learning (PBL) is best seen as one of a number of moves towards making learning more student-centered. When PBL was implemented in the course of Pathophysiology, the course became the least important one. Two major problems appeared in our school, including ineffective learning in self-directed study. To improve the effectiveness of self-directed learning, our approach was to ask students submit a newly synthesized reasoning schema through a Web-based iTEACH system and integrate case-based reasoning into student presentation. Therefore, the purpose of this study was to explore if case-based reasoning improved the effectiveness of PBL in Pathophysiology.

**METHODS**

From 2006 to 2009, an annual evaluation of student perception of “overall satisfaction on PBL Pathophysiology was conducted by the Center for Education at the National Cheng Kung University Hospital. In 2009, a student survey of PBL Pathophysiology was conducted by the course coordinator.

**RESULTS**

The annual survey showed that student perception of “self-evaluated attention in Medical Physiology” was significantly greater in 2009 than that in the year before. Of six courses taken in the same semester, PBL Pathophysiology was the third course on the top. **CONCLUSION** Integration of case-based reasoning into PBL provides an alternative tool to improve the effectiveness of self-directed study on the basis of Web-based teaching system.

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